

CLAIMS

What is claimed is:

1. An apparatus for forming solder balls comprising:

a substrate; and

a stencil disposed on the substrate, the stencil having a plurality of holes extending therethrough.

2. The apparatus, as set forth in claim 1, wherein the substrate comprises an upper surface on which the stencil is disposed, the upper surface of the substrate having a plurality of wettable pads, wherein each of the plurality of holes in the stencil are positioned over a respective one of the plurality of wettable pads.

3. The apparatus, as set forth in claim 1, wherein the substrate comprises a non-wettable material.

4. The apparatus, as set forth in claim 1, wherein the substrate comprises a printed circuit board.

5. The apparatus, as set forth in claim 1, wherein the substrate comprises a ceramic substrate.

5 6. The apparatus, as set forth in claim 1, wherein the stencil comprises a non-wettable material.

7. The apparatus, as set forth in claim 1, wherein the plurality of holes in the stencil
10 are all of uniform size.

8. The apparatus, as set forth in claim 1, wherein the plurality of holes in the stencil
are all of uniform volume.

15 9. The apparatus, as set forth in claim 1, further comprising solder disposed in each of the plurality of holes in the stencil.

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10. An apparatus for forming solder balls comprising:

a non-wettable substrate having an upper surface; and

5 a non-wettable stencil having an upper surface and a lower surface, the lower surface of the stencil being disposed on the upper surface of the substrate, the stencil having a plurality of holes having uniform volume extending from the upper surface of the stencil through the lower surface of the stencil.

10 11. The apparatus, as set forth in claim 10, wherein the upper surface of the substrate comprises a plurality of wettable pads, wherein each of the plurality of holes in the stencil are positioned over a respective one of the plurality of wettable pads.

15 12. The apparatus, as set forth in claim 10, wherein the substrate comprises a printed circuit board.

20 13. The apparatus, as set forth in claim 10, wherein the substrate comprises a ceramic substrate.

14. The apparatus, as set forth in claim 10, wherein the plurality of holes in the stencil are all of uniform size.

5 15. The apparatus, as set forth in claim 10, further comprising solder disposed in each of the plurality of holes in the stencil.

10 16. The apparatus, as set forth in claim 10, wherein each of the plurality of holes in the stencil have a width greater than a diameter of a solder ball formed within each respective hole.

15 17. The apparatus, as set forth in claim 10, wherein the stencil is removable from the substrate.

18. The apparatus, as set forth in claim 10, wherein the stencil is not removable from the substrate.

19. A system for forming solder balls comprising:

a conveyor belt having a first surface and a second surface and having a plurality of holes
in the first surface extending partially through the conveyor belt;

a drive device coupled to the conveyor belt to move the conveyor belt along a given path;

a solder dispensing device arranged relative to the conveyor belt to dispense solder within
the holes in the first surface of the conveyor belt; and

a heating device positioned downstream of the solder dispensing device and arranged
relative to the conveyor belt to melt the solder within the holes in the first surface
of the conveyor belt to form a plurality of solder balls.

20. The system, as set forth in claim 19, wherein the conveyor belt comprises a first
portion and a second portion, the first portion comprising a non-wettable substrate having an
upper surface and the second portion comprising a non-wettable stencil having an upper surface
and a lower surface, the lower surface of the stencil being disposed on the upper surface of the
substrate; the stencil having a plurality of holes having uniform volume extending from the upper
surface of the stencil through the lower surface of the stencil.

21. The system, as set forth in claim 19, wherein the conveyor belt comprises a non-wettable material.

5 22. The system, as set forth in claim 19, wherein the holes in the conveyor belt are all of uniform size.

10 23. The system, as set forth in claim 19, wherein the holes in the conveyor belt are all of uniform volume.

15 24. The system, as set forth in claim 19, wherein each of the plurality of holes in the conveyor belt have a width greater than a diameter of a solder ball formed within each respective hole.

20 25. The system, as set forth in claim 19, wherein the conveyor belt comprises one of stainless steel and titanium.

26. The system, as set forth in claim 19, wherein the drive device comprises a pair of rollers about which the conveyor belt is disposed, at least one of the pair of rollers being driven to move the conveyor belt along the given path..

27. The system, as set forth in claim 19, wherein the solder dispensing device comprises a receptacle for holding a supply of solder paste.

28. The system, as set forth in claim 19, wherein the solder dispensing device comprises a squeegee positioned adjacent the first surface of the conveyor belt to deposit the solder paste within the holes in the first surface of the conveyor belt.

29. The system, as set forth in claim 19, wherein the heating device comprises a furnace through which the conveyor belt passes.

30. The system, as set forth in claim 19, further comprising a cleaning device positioned downstream of the heating device and arranged relative to the conveyor belt to clean the solder balls.

31. The system, as set forth in claim 19, further comprising a catch basin positioned downstream of the heating device and arranged relative to the conveyor belt to receive solder balls transferred from the conveyor belt.

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32. The system, as set forth in claim 19, further comprising a transfer device positioned downstream of the heating device and arranged relative to the conveyor belt to discharge the solder balls from the conveyor belt.

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33. The system, as set forth in claim 32, wherein the transfer device comprises a vibrator which vibrates the conveyor belt to discharge the solder balls from the conveyor belt.

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34. A plurality of uniformly sized solder balls fabricated by disposing solder paste into a like plurality of uniformly sized holes in a stencil disposed on a substrate and by melting the solder paste in the like plurality of uniformly sized holes to form the plurality of solder balls.

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35. A method of forming solder balls, the method comprising the acts of:

- (a) providing a stencil disposed on a substrate, the stencil having a plurality of holes therein;

- (b) disposing solder within the plurality of holes; and
- (c) heating the solder disposed within the holes of the stencil disposed on the substrate to form a solder ball within each hole.

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36. The method, as set forth in claim 35, wherein act (a) comprises the act of:

coupling the stencil to the substrate.

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37. The method, as set forth in claim 36, wherein the act of coupling comprises the
act of:

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clamping the stencil to the substrate.

38. The method, as set forth in claim 35, wherein act (a) comprises the act of:

providing the stencil integral with the substrate.

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39. The method, as set forth in claim 35, wherein the substrate comprises an upper surface on which the stencil is disposed, the upper surface of the substrate having a plurality of wettable pads, and wherein act (a) comprises the act of:

5 positioning each of the plurality of holes in the stencil over a respective one of the plurality of wettable pads.

40. The method, as set forth in claim 35, wherein act (a) comprises the act of:

0 providing the substrate which comprises a non-wettable material.

41. The method, as set forth in claim 35, wherein act (a) comprises the act of:

15 providing the substrate which comprises a printed circuit board.

42. The method, as set forth in claim 35, wherein act (a) comprises the act of:

20 providing the substrate which comprises a ceramic substrate.

43. The method, as set forth in claim 35, wherein act (a) comprises the act of:

providing the stencil which comprises a non-wettable material.

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44. The method, as set forth in claim 35, wherein act (a) comprises the act of:

providing the plurality of holes in the stencil which are all of uniform size.

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45. The method, as set forth in claim 35, wherein act (a) comprises the act of:

providing the plurality of holes in the stencil which are all of uniform volume.

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46. The method, as set forth in claim 35, wherein act (a) comprises the act of:

providing each of the plurality of holes in the stencil having a width greater than a
diameter of a solder ball formed within each respective hole.

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47. The method, as set forth in claim 35, wherein act (a) comprises the act of:

providing the stencil and substrate as a conveyor belt.

48. The method, as set forth in claim 35, wherein act (b) comprises the acts of:

disposing solder paste on the stencil; and

moving a squeegee relative to the stencil to dispose the solder paste into the plurality of
holes in the stencil.

49. The method, as set forth in claim 47, wherein act (b) comprises the act of:

disposing solder paste on the conveyor belt; and

moving the conveyor belt along a given path relative to an adjacent squeegee to dispose
the solder paste into the plurality of holes in the stencil.

50. The method, as set forth in claim 47, wherein act (c) comprises the act of:

moving the conveyor belt along the given path through a furnace.

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51. The method, as set forth in claim 39, further comprising the act of:

removing the stencil from the substrate subsequent to formation of the solder balls.

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52. The method, as set forth in claim 35, further comprising the act of:

removing the solder balls from the stencil and substrate.

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53. The method, as set forth in claim 35, wherein the acts are performed in order of recitation.